

NOV-30-2004 12:21

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281 834 0305

P.03/19

Replacement Page 105

IPTA/US

## CLAIMS

What is claimed is:

1. A copolymer comprising an isoolefin and a multiolefin, the copolymer being substantially free of long chain branching; wherein the copolymer has a g'<sub>vis,avg.</sub> from greater than or equal to 0.978 as determined by triple detection SEC.
2. The copolymer of claim 1, wherein the multiolefin is a conjugated diene, preferably isoprene.
3. The copolymer of claim 1, wherein the multiolefin content is from greater than 0.5 mol%.
4. The copolymer of claim 1, wherein the multiolefin content is from greater than 1.0 mol%.
5. The copolymer of claim 1, wherein the multiolefin content is from greater than 2.5 mol%.
6. The copolymer of claim 1, wherein the multiolefin content is from greater than 5.0 mol%.
7. A copolymer comprising isobutylene and isoprene, the copolymer being substantially free of long chain branching; wherein the copolymer has a g'<sub>vis,avg.</sub> from greater than or equal to 0.978 as determined by triple detection SEC.
8. The copolymer of claim 7, wherein the isoprene content is from greater than 0.5 mol%.

105A/US

NOV-30-2004 12:21

B

281 834 0305

P.04/19

## Replacement Page 106

9. The copolymer of claim 7, wherein the isoprene content is from greater than 1.0 mol%.
10. The copolymer of claim 7, wherein the isoprene content is from greater than 2.5 mol%.
11. The copolymer of claim 7, wherein the isoprene content is from greater than 5.0 mol%.
12. A copolymer produced by the process comprising contacting an isoolefin, preferably isobutylene, a multiolefin, preferably isoprene, one or more Lewis acid(s), one or more initiator(s), and a diluent comprising one or more hydrofluorocarbon(s) (HFC's); wherein the copolymer is substantially free of long chain branching and wherein the copolymer has a g'vis.avg. from greater than or equal to 0.978 as determined by triple detection SEC.
13. The copolymer of claim 12, wherein the multiolefin is a conjugated diene.
14. The copolymer of claim 12, wherein the multiolefin content is from greater than 0.5 mol%.
15. The copolymer of claim 12, wherein the multiolefin content is from greater than 1.0 mol%.
16. The copolymer of claim 12, wherein the multiolefin content is from greater than 2.5 mol%.
17. The copolymer of claim 12, wherein the multiolefin content is from greater than 5.0 mol%.

NOV 30 2004 12:22

B

IPCA/MS

281 834 0305

P.05/19

## Replacement Page 107

18. The copolymer of claim 12, wherein one or more hydrofluorocarbon(s) is represented by the formula:  $C_xH_yF_z$  wherein x is an integer from 1 to 40 and y and z are integers of one or more.

19. The copolymer of claim 18, wherein x is from 1 to 10.

20. The copolymer of claim 18, wherein x is from 1 to 6.

21. The copolymer of claim 18, wherein x is from 1 to 3.

22. The copolymer of claim 12, wherein the one or more hydrofluorocarbon(s) is independently selected from the group consisting of fluoromethane; difluoromethane; trifluoromethane; fluoroethane; 1,1-difluoroethane; 1,2-difluoroethane; 1,1,1-trifluoroethane; 1,1,2-trifluoroethane; 1,1,1,2-tetrafluoroethane; 1,1,2,2-tetrafluoroethane; 1,1,1,2,2-pentafluoroethane; 1-fluoropropane; 2-fluoropropane; 1,1-difluoropropane; 1,2-difluoropropane; 1,3-difluoropropane; 2,2-difluoropropane; 1,1,1-trifluoropropane; 1,1,2-trifluoropropane; 1,1,3-trifluoropropane; 1,2,2-trifluoropropane; 1,2,3-trifluoropropane; 1,1,1,2-tetrafluoropropane; 1,1,1,3-tetrafluoropropane; 1,1,2,2-tetrafluoropropane; 1,1,2,3-tetrafluoropropane; 1,1,3,3-tetrafluoropropane; 1,2,2,3-tetrafluoropropane; 1,1,1,2,2-pentafluoropropane; 1,1,1,2,3-pentafluoropropane; 1,1,1,3,3-pentafluoropropane; 1,1,2,2,3-pentafluoropropane; 1,1,1,2,2,3-hexafluoropropane; 1,1,1,2,2,3-hexafluoropropane; 1,1,1,2,2,3-heptafluoropropane; 1-fluorobutane; 2-fluorobutane; 1,1-difluorobutane; 1,2-difluorobutane; 1,3-difluorobutane; 1,1,1,4-difluorobutane; 2,2-difluorobutane; 2,3-difluorobutane; 1,1,1-trifluorobutane; 1,1,2-trifluorobutane; 1,1,3-trifluorobutane; 1,1,4-trifluorobutane; 1,2,2-trifluorobutane; 1,2,3-trifluorobutane; 1,3,3-trifluorobutane; 2,2,3-trifluorobutane; 1,1,1,2-tetrafluorobutane; 1,1,1,3-tetrafluorobutane; 1,1,1,4-tetrafluorobutane; 1,1,2,2-tetrafluorobutane;

NOV-30-2004 12:22

B

281 834 0305

P.06/19

## Replacement Page 108

1,1,2,3-tetrafluorobutane;	1,1,2,4-tetrafluorobutane;	1,1,3,3-
tetrafluorobutane;	1,1,3,4-tetrafluorobutane;	1,1,4,4-tetrafluorobutane;
1,2,2,3-tetrafluorobutane;	1,2,2,4-tetrafluorobutane;	1,2,3,3-
tetrafluorobutane;	1,2,3,4-tetrafluorobutane;	2,2,3,3-tetrafluorobutane;
1,1,1,2,2-pentafluorobutane;	1,1,1,2,3-pentafluorobutane;	1,1,1,2,4-
pentafluorobutane;	1,1,1,3,3-pentafluorobutane;	1,1,1,3,4-
pentafluorobutane;	1,1,1,4,4-pentafluorobutane;	1,1,2,2,3-
pentafluorobutane;	1,1,2,2,4-pentafluorobutane;	1,1,2,3,3-
pentafluorobutane;	1,1,2,4,4-pentafluorobutane;	1,1,3,3,4-
pentafluorobutane;	1,2,2,3,3-pentafluorobutane;	1,2,2,3,4-
pentafluorobutane;	1,1,1,2,2,3-hexafluorobutane;	1,1,1,2,2,4-
hexafluorobutane;	1,1,1,2,3,3-hexafluorobutane,	1,1,1,2,3,4-
hexafluorobutane;	1,1,1,2,4,4-hexafluorobutane;	1,1,1,3,3,4-
hexafluorobutane;	1,1,1,3,4,4-hexafluorobutane;	1,1,1,4,4,4-
hexafluorobutane;	1,1,2,2,3,3-hexafluorobutane;	1,1,2,2,3,4-
hexafluorobutane;	1,1,2,2,4,4-hexafluorobutane;	1,1,2,3,3,4-
hexafluorobutane;	1,1,2,3,4,4-hexafluorobutane;	1,2,2,3,3,4-
hexafluorobutane;	1,1,1,2,2,3,3-heptafluorobutane;	1,1,1,2,2,4,4-
heptafluorobutane;	1,1,1,2,2,3,4-heptafluorobutane;	1,1,1,2,3,3,4-
heptafluorobutane;	1,1,1,2,3,4,4-heptafluorobutane;	1,1,1,2,4,4,4-
heptafluorobutane;	1,1,1,3,3,4,4-heptafluorobutane;	1,1,1,2,2,3,3,4-
octafluorobutane;	1,1,1,2,2,3,4,4-octafluorobutane;	1,1,1,2,3,3,4,4-
octafluorobutane;	1,1,1,2,2,4,4,4-octafluorobutane;	1,1,1,2,3,4,4,4-
octafluorobutane;	1,1,1,2,2,3,3,4,4-nonafluorobutane;	1,1,1,2,2,3,4,4,4-
nonafluorobutane;	1-fluoro-2-methylpropane;	1,1-difluoro-2-
methylpropane;	1,3-difluoro-2-methylpropane;	1,1,1-trifluoro-2-
methylpropane;	1,1,3-trifluoro-2-methylpropane;	1,3-difluoro-2-
(fluoromethyl)propane;	1,1,1,3-tetrafluoro-2-methylpropane;	1,1,3,3-
tetrafluoro-2-methylpropane;	1,1,3-trifluoro-2-(fluoromethyl)propane;	tetrafluoro-2-
1,1,1,3,3-pentafluoro-2-methylpropane;		1,1,3,3-tetrafluoro-2-
(fluoromethyl)propane;	1,1,1,3-tetrafluoro-2-(fluoromethyl)propane;	(fluoromethyl)propane;
fluorocyclobutane;	1,1-difluorocyclobutane;	1,2-difluorocyclobutane;
		1,3-

NOV-30-2004 12:22

B

IPEA/281 834 0305 P. 07/19

Replacement Page 109

difluorocyclobutane;	1,1,2-trifluorocyclobutane;	1,1,3-
trifluorocyclobutane;	1,2,3-trifluorocyclobutane;	1,1,2,2-
tetrafluorocyclobutane;	1,1,3,3-tetrafluorocyclobutane;	1,1,2,2,3-
pentafluorocyclobutane;	1,1,2,3,3-pentafluorocyclobutane;	1,1,2,2,3,3-
hexafluorocyclobutane;	1,1,2,2,3,4-hexafluorocyclobutane;	1,1,2,3,3,4-
hexafluorocyclobutane;	1,1,2,2,3,4-heptafluorocyclobutane;	vinyl
	fluoride; 1,1-difluoroethene; 1,2-difluoroethene; 1,1,2-trifluoroethene; 1-	
fluoropropene,	1,1-difluoropropene; 1,2-difluoropropene;	1,3-
disfluoropropene;	2,3-difluoropropene; 3,3-difluoropropene;	1,1,2-
trifluoropropene;	1,1,3-trifluoropropene; 1,2,3-trifluoropropene;	1,3,3-
trifluoropropene;	2,3,3-trifluoropropene; 3,3,3-trifluoropropene; 1-fluoro-	
1-butene; 2-fluoro-1-butene; 3-fluoro-1-butene; 4-fluoro-1-butene;	1,1-difluoro-1-butene; 1,2-difluoro-1-butene; 1,3-difluoropropene;	1,4-
1-butene; 2,3-difluoro-1-butene; 2,4-difluoro-1-butene;	3,3-difluoro-1-butene; 3,4-difluoro-1-butene; 4,4-difluoro-1-butene;	3,3-
1,1,2-difluoro-1-butene; 3,4-difluoro-1-butene; 4,4-difluoro-1-butene;	1,1,3-trifluoro-1-butene; 1,1,4-trifluoro-1-butene; 1,2,3-	
1,1,3-trifluoro-1-butene; 1,1,4-trifluoro-1-butene; 1,2,3-trifluoro-1-butene;	1,2,4-trifluoro-1-butene; 1,3,3-trifluoro-1-butene; 1,3,4-	
1,2,4-trifluoro-1-butene; 1,3,3-trifluoro-1-butene; 1,3,4-trifluoro-1-butene;	1,4,4-trifluoro-1-butene; 2,3,3-trifluoro-1-butene; 2,3,4-	
1,4,4-trifluoro-1-butene; 2,3,3-trifluoro-1-butene; 3,3,4-trifluoro-1-butene;	3,3,4-trifluoro-1-butene; 2,4,4-trifluoro-1-butene; 3,3,4-trifluoro-1-butene;	3,4,4-
3,3,4-trifluoro-1-butene; 2,4,4-trifluoro-1-butene; 3,3,4-trifluoro-1-butene;	4,4,4-trifluoro-1-butene; 1,1,2,3-tetrafluoro-1-butene;	
4,4,4-trifluoro-1-butene; 1,1,2,3-tetrafluoro-1-butene; 1,1,3,3-tetrafluoro-1-butene;	1,1,3,4-1,1,2,4-tetrafluoro-1-butene;	1,1,3,4-
1,1,3,3-tetrafluoro-1-butene; 1,1,4,4-tetrafluoro-1-butene; 1,2,3,3-tetrafluoro-1-	1,1,4,4-tetrafluoro-1-butene; 1,2,3,4-tetrafluoro-1-butene;	
butene; 1,2,3,4-tetrafluoro-1-butene; 1,2,4,4-tetrafluoro-1-butene; 1,3,3,4-tetrafluoro-1-butene;	1,3,4,4-tetrafluoro-1-butene; 1,4,4,4-tetrafluoro-1-butene;	
1,3,4,4-tetrafluoro-1-butene; 1,4,4,4-tetrafluoro-1-butene; 2,4,4,4-butene;	2,3,3,4-tetrafluoro-1-butene; 2,3,4,4-tetrafluoro-1-butene;	2,4,4,4-
2,3,3,4-tetrafluoro-1-butene; 2,3,4,4-tetrafluoro-1-butene; 3,3,4,4-tetrafluoro-1-butene;	3,3,4,4-tetrafluoro-1-butene; 1,1,2,3,4-pentafluoro-1-butene;	
3,3,4,4-tetrafluoro-1-butene; 1,1,2,3,4-pentafluoro-1-butene; 1,1,3,3,4-pentafluoro-1-butene;	1,1,3,4-pentafluoro-1-butene; 1,1,4,4-pentafluoro-1-butene;	1,2,3,3,4-
1,1,3,4-pentafluoro-1-butene; 1,1,4,4-pentafluoro-1-butene; 1,2,3,4-pentafluoro-1-butene;	1,2,3,4-pentafluoro-1-butene; 2,3,3,4-pentafluoro-1-butene;	1,2,4,4,4-
1,2,3,4-pentafluoro-1-butene; 2,3,3,4-pentafluoro-1-butene; 3,3,4,4-pentafluoro-1-butene;	3,3,4,4-pentafluoro-1-butene; 1,1,2,3,3,4-pentafluoro-1-butene;	2,3,4,4,4-

NOV-30-2004 12:22

B

281 834 0305

P.08/19

IPEA /US

Replacement Page 110

hexafluoro-1-butene; 1,1,2,3,4,4-hexafluoro-1-butene; 1,1,2,4,4,4-  
 hexafluoro-1-butene; 1,2,3,3,4,4-hexafluoro-1-butene; 1,2,3,4,4,-  
 hexafluoro-1-butene; 2,3,3,4,4,4-hexafluoro-1-butene; 1,1,2,3,3,4,4-  
 heptafluoro-1-butene; 1,1,2,3,4,4,4-heptafluoro-1-butene; 1,1,3,3,4,4,-  
 heptafluoro-1-butene; 1,2,3,3,4,4,4-heptafluoro-1-butene; 1-fluoro-2-  
 butene; 2-fluoro-2-butene; 1,1-difluoro-2-butene; 1,2-difluoro-2-butene;  
 1,3-difluoro-2-butene; 1,4-difluoro-2-butene; 2,3-difluoro-2-butene; 1,1,1-  
 trifluoro-2-butene; 1,1,2-trifluoro-2-butene; 1,1,3-trifluoro-2-butene; 1,1,4-  
 trifluoro-2-butene; 1,2,3-trifluoro-2-butene; 1,2,4-trifluoro-2-butene;  
 1,1,1,2-tetrafluoro-2-butene; 1,1,1,3-tetrafluoro-2-butene; 1,1,1,4-  
 tetrafluoro-2-butene; 1,1,2,3-tetrafluoro-2-butene; 1,1,2,4-tetrafluoro-2-  
 butene; 1,2,3,4-tetrafluoro-2-butene; 1,1,1,2,3-pentafluoro-2-butene;  
 1,1,1,2,4-pentafluoro-2-butene; 1,1,1,3,4-pentafluoro-2-butene; 1,1,1,4,4-  
 pentafluoro-2-butene; 1,1,2,3,4-pentafluoro-2-butene; 1,1,2,4,4-  
 pentafluoro-2-butene; 1,1,1,2,3,4-hexafluoro-2-butene; 1,1,1,2,4,4-  
 hexafluoro-2-butene; 1,1,1,3,4,4-hexafluoro-2-butene; 1,1,1,2,3,4,4-  
 heptafluoro-2-butene; 1,1,1,2,4,4,4-heptafluoro-2-butene; and mixtures  
 thereof.

- 23. The copolymer of claim 12, wherein the one or more hydrofluorocarbon(s) is independently selected from the group consisting of fluoromethane, difluoromethane, trifluoromethane, 1,1-difluoroethane, 1,1,1-trifluoroethane, 1,1,1,2-tetrafluoroethane, and mixtures thereof.
- 24. The copolymer of claim 12, wherein the diluent comprises from 15 to 100 volume % HFC based upon the total volume of the diluent.
- 25. The copolymer of claim 12, wherein the diluent comprises from 20 to 100 volume % HFC based upon the total volume of the diluent.

NOV-30-2004 12:23

B

281 834 0305

P.09/19

Replacement Page 111

/PDA/CS

26. The copolymer of claim 12, wherein the diluent comprises from 25 to 100 volume % HFC based upon the total volume of the diluent.
27. The copolymer of claim 12, wherein the diluent further comprises a hydrocarbon, a non-reactive olefin, and/or an inert gas.
28. The copolymer of claim 27, wherein the hydrocarbon is a halogenated hydrocarbon other than an HFC.
29. The copolymer of claim 28, wherein the halogenated hydrocarbon is methyl chloride.
30. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $MX_4$ ;  
wherein M is a Group 4, 5, or 14 metal; and  
each X is a halogen.
31. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $MR_nX_{4-n}$ ;  
wherein M is Group 4, 5, or 14 metal;  
each R is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;  
 $n$  is an integer from 0 to 4; and  
each X is a halogen.
32. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $M(RO)_nR'mX_{4-(m+n)}$ ;  
wherein M is Group 4, 5, or 14 metal;  
each RO is a monovalent C<sub>1</sub> to C<sub>30</sub> hydrocarboxy radical independently selected from the group consisting of an alkoxy, aryloxy, arylalkoxy, alkylaryloxy radicals;

NOV-30-2004 12:23

B

281 834 0305

P.10/19

Replacement Page 112

/DEA/US

each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

n is an integer from 0 to 4;

m is an integer from 0 to 4, wherein the sum of n and m is not more than 4;

and

each X is a halogen.

33. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula M(RC=OO)<sub>n</sub>R'<sub>m</sub>X<sub>4-(m+n)</sub>;

wherein M is Group 4, 5, or 14 metal;

each RC=OO is a monovalent C<sub>2</sub> to C<sub>30</sub> hydrocarbacyl radical independently selected from the group consisting of an alkacyloxy, arylacyloxy, arylalkylacyloxy, alkylarylcycloxy radicals;

each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

n is an integer from 0 to 4;

m is an integer from 0 to 4, wherein the sum of n and m is not more than 4;

and

each X is a halogen.

34. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula MOX<sub>3</sub>;

wherein M is a Group 5 metal; and

each X is a halogen.

35. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula MX<sub>3</sub>;

wherein M is a Group 13 metal; and

each X is a halogen.

IPEN/US

NOV-30-2004 12:23

B

281 834 0305

P.11/19

Replacement Page 113

36. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $MR_nX_{3-n}$  ;  
 wherein M is a Group 13 metal;  
 each R is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;  
 n is an integer from 1 to 3; and  
 each X is a halogen.

37. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $M(RO)_nR'mX_{3-(m+n)}$  ;  
 wherein M is a Group 13 metal;  
 each RO is a monovalent C<sub>1</sub> to C<sub>30</sub> hydrocarboxy radical independently selected from the group consisting of an alkoxy, aryloxy, arylalkoxy, alkylaryloxy radicals;  
 each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;  
 n is an integer from 0 to 3;  
 m is an integer from 0 to 3, wherein the sum of n and m is from 1 to 3; and  
 each X is a halogen.

38. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $M(RC=OO)_nR'mX_{3-(m+n)}$  ;  
 wherein M is a Group 13 metal;  
 each RC=OO is a monovalent hydrocarbacyl radical independently selected from the group independently selected from the C<sub>2</sub> to C<sub>30</sub> group consisting of an alkacyloxy, arylacyloxy, arylalkylacyloxy, alkylarylacyloxy radicals;  
 each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

IPDA/US

NOV-30-2004 12:23

B

281 834 0305

P. 12/19

Replacement Page 114

IPDA/US

*n* is an integer from 0 to 3;*m* is a integer from 0 to 3, wherein the sum of *n* and *m* is from 1 to 3; and each X is a halogen.

39. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $MX_y$ ;  
 wherein M is a Group 15 metal;  
 each X is a halogen; and  
*y* is 3, 4 or 5.

40. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $MR_nX_{y-n}$ ;  
 wherein M is a Group 15 metal;  
 each R is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;  
*n* is an integer from 0 to 4;  
*y* is 3, 4 or 5, wherein *n* is less than *y*; and  
 each X is a halogen.

41. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $M(RO)_nR'mX_{y-(m+n)}$ ;  
 wherein M is a Group 15 metal,  
 each RO is a monovalent C<sub>1</sub> to C<sub>30</sub> hydrocarboxy radical independently selected from the group consisting of an alkoxy, aryloxy, arylalkoxy, alkylaryloxy radicals;  
 each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;  
*n* is an integer from 0 to 4;  
*m* is an integer from 0 to 4;  
*y* is 3, 4 or 5, wherein the sum of *n* and *m* is less than *y*; and

100A/US

NOV-30-2004 12:23

B

281 834 0305

P.13/19

Replacement Page 115

each X is a halogen.

42. The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by the formula  $M(RC=OO)_nR'mX_{y-(m+n)}$ ;

wherein M is a Group 15 metal;

each RC=OO is a monovalent C<sub>2</sub> to C<sub>30</sub> hydrocarbacyloxy radical independently selected from the group consisting of an alkacyloxy, arylacyloxy, arylalkylacyloxy, alkylarylcyclaxy radicals;

each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

n is an integer from 0 to 4;

m is an integer from 0 to 4;

y is 3, 4 or 5, wherein the sum of n and m is less than y; and

each X is a halogen.

43. The copolymer of claim 12, wherein the one or more Lewis acid(s) is independently selected from the group consisting of titanium tetrachloride, titanium tetrabromide, vanadium tetrachloride, tin tetrachloride, zirconium tetrachloride, titanium bromide trichloride, titanium dibromide dichloride, vanadium bromide trichloride, tin chloride trifluoride, benzyltitanium trichloride, dibenzyltitanium dichloride, benzylzirconium trichloride, dibenzylzirconium dibromide, methyltitanium trichloride, dimethyltitanium difluoride, dimethyltin dichloride, phenylvanadium trichloride, methoxytitanium trichloride, n-butoxytitanium trichloride, di(isopropoxy)titanium dichloride, phenoxytitanium tribromide, phenylmethoxyzirconium trifluoride, methyl methoxytitanium dichloride, methyl methoxytin dichloride, benzyl isopropoxyvanadium dichloride, acetoxytitanium trichloride, benzoylzirconium tribromide, benzyloxytitanium trifluoride, isopropoxytin trichloride, methyl acetoxytitanium dichloride, benzyl benzyloxyvanadium chloride, vanadium oxytrichloride, aluminum trichloride, boron trifluoride, gallium

NOV-30-2004 12:24

B

281 834 0305

P.14/19

Replacement Page 116

trichloride, indium trifluoride, ethylaluminum dichloride, methylaluminum dichloride, benzylaluminum dichloride, isobutylgallium dichloride, diethylaluminum chloride, dimethylaluminum chloride, ethylaluminum sesquichloride, methylaluminum sesquichloride, trimethylaluminum, triethylaluminum, methoxyaluminum dichloride, ethoxyaluminum dichloride, 2,6-di-tert-butylphenoxyaluminum dichloride, methoxy methylaluminum chloride, 2,6-di-tert-butylphenoxy methylaluminum chloride, isopropoxygallium dichloride, phenoxy methylindium fluoride, acetoxyaluminum dichloride, benzyloxyaluminum dibromide, benzyloxygallium difluoride, methyl acetoxyaluminum chloride, isopropoxyindium trichloride, antimony hexachloride, antimony hexafluoride, arsenic pentafluoride, antimony chloride pentafluoride, arsenic trifluoride, bismuth trichloride arsenic fluoride tetrachloride, tetraphenylantimony chloride, triphenylantimony dichloride, tetrachloromethoxyantimony, dimethoxytrichloroantimony, dichloromethoxyarsine, chlorodimethoxyarsine, difluoromethoxyarsine, acetatotetrachloroantimony, (benzoato) tetrachloroantimony, and bismuth acetate chloride.

44. The copolymer of claim 12, wherein the one or more Lewis acid(s) is independently selected from the group consisting of aluminum trichloride, aluminum tribromide, ethylaluminum dichloride, ethylaluminum sesquichloride, diethylaluminum chloride, methylaluminum dichloride, methylaluminum sesquichloride, dimethylaluminum chloride, boron trifluoride, and titanium tetrachloride.
45. The copolymer of claim 12, wherein the Lewis acid is not a compound represented by formula  $MX_3$ , where M is a group 13 metal, X is a halogen.
46. The copolymer of claim 12, wherein the one or more initiator(s) comprise a hydrogen halide, a carboxylic acid, a carboxylic acid halide, a sulfonic acid, an alcohol, a phenol, a polymeric halide, a tertiary alkyl halide, a

NOV-30-2004 12:24

B

281 834 0305

P.15/19

Replacement Page 117

tertiary aralkyl halide, a tertiary alkyl ester, a tertiary aralkyl ester, a tertiary alkyl ether, a tertiary aralkyl ether, an alkyl halide, an aryl halide, an alkylaryl halide or an arylalkylacid halide.

47. The copolymer of claim 12, wherein the one or more initiator(s) is independently selected from the group consisting of HCl, H<sub>2</sub>O, methanol, (CH<sub>3</sub>)<sub>3</sub>CCl, C<sub>6</sub>H<sub>5</sub>C(CH<sub>3</sub>)<sub>2</sub>Cl, (2-Chloro-2,4,4-trimethylpentane) and 2-chloro-2-methylpropane.
48. The copolymer of claim 12, wherein the one or more initiator(s) is independently selected from the group consisting of hydrogen chloride, hydrogen bromide, hydrogen iodide, acetic acid, propanoic acid, butanoic acid; cinnamic acid, benzoic acid, 1-chloroacetic acid, dichloroacetic acid, trichloroacetic acid, trifluoroacetic acid, p-chlorobenzoic acid, p-fluorobenzoic acid, acetyl chloride, acetyl bromide, cinnamyl chloride, benzoyl chloride, benzoyl bromide, trichloroacetylchloride, trifluoroacetylchloride, p-fluorobenzoylchloride, methanesulfonic acid, trifluoromethanesulfonic acid, trichloromethanesulfonic acid, p-toluenesulfonic acid, methanesulfonyl chloride, methanesulfonyl bromide, trichloromethanesulfonyl chloride, trifluoromethanesulfonyl chloride, p-toluenesulfonyl chloride, methanol, ethanol, propanol, 2-propanol, 2-methylpropan-2-ol, cyclohexanol, benzyl alcohol, phenol, 2-methylphenol, 2,6-dimethylphenol, p-chlorophenol, p-fluorophenol, 2,3,4,5,6-pentafluorophenol, and 2-hydroxynaphthalene.
49. The copolymer of claim 12, wherein the one or more initiator(s) is independently selected from the group consisting of 2-chloro-2,4,4-trimethylpentane; 2-bromo-2,4,4-trimethylpentane; 2-chloro-2-methylpropane; 2-bromo-2-methylpropane; 2-chloro-2,4,4,6,6-pentamethylheptane; 1-chloro-1-pentamethylheptane; 2-bromo-2,4,4,6,6-pentamethylheptane; 1-chloro-1-methylethylbenzene; 1-chloroadamantane; 1-chloroethylbenzene; 1, 4-bis(1-chloro-1-methylethyl) benzene; 5-tert-butyl-1,3-bis(1-chloro-1-

IPEA/US

NOV-30-2004 12:24

B

281 834 0305

P.16/19

Replacement Page 118

methylethyl) benzene; 2-acetoxy-2,4,4-trimethylpentane; 2-benzoyloxy-methylethyl) benzene; 2-acetoxy-2-methylpropane; 2-benzoyloxy-2-2,4,4-trimethylpentane; 2-acetoxy-2,4,4,6,6-pentamethylheptane; 2-benzoyl-methylpropane; 2-acetoxy-2,4,4,6,6-pentamethylheptane; 1-2,4,4,6,6-pentamethylheptane; 1-acetoxy-1-methylethylbenzene; 1-acetoxyadamantane; 1-benzoyloxyethylbenzene; 1,4-bis(1-acetoxy-1-methylethyl) benzene; 5-tert-butyl-1,3-bis(1-acetoxy-1-methylethyl) benzene; 2-methoxy-2,4,4-trimethylpentane; 2-isopropoxy-2,4,4-benzene; 2-methoxy-2-methylpropane; 2-benzylbenzene; 2-benzylbenzene; 2-methoxy-2,4,4,6,6-pentamethylheptane; 2-isopropoxy-methylpropane; 2-methoxy-2,4,4,6,6-pentamethylheptane; 1-methoxy-1-methylethylbenzene; 1-2,4,4,6,6-pentamethylheptane; 1-methoxy-1-methylethylbenzene; 1-methoxyadamantane; 1-methoxyethylbenzene; 1,4-bis(1-methoxy-1-methylethyl) benzene; 5-tert-butyl-1,3-bis(1-methoxy-1-methylethyl) benzene, and 1,3,5-tris(1-chloro-1-methylethyl) benzene.

50. The copolymer of claim 12, wherein the one or more initiator(s) further comprise a weakly-coordinating anion.
51. The copolymer of claim 12, wherein the one or more initiator(s) comprise greater than 30 ppm water (based upon weight).
52. The copolymer of claim 12, wherein the contacting further comprises contacting one or more monomer(s) independently selected from the group consisting of olefins, alpha-olefins, disubstituted olefins, isoolefins, conjugated dienes, non-conjugated dienes, styrenics, substituted styrenics, and vinyl ethers.
53. The copolymer of claim 12, wherein the contacting further comprises contacting one or more monomer(s) independently selected from the group consisting of styrene, para-alkylstyrene, para-methylstyrene, alpha-methyl styrene, divinylbenzene, diisopropenylbenzene, isobutylene, 2-methyl-1-butene, 3-methyl-1-butene, 2-methyl-2-pentene, isoprene, butadiene, 2,3-dimethyl-1,3-butadiene,  $\beta$ -pinene, myrcene, 6,6-dimethyl-fulvene,

NOV-30-2004 12:25

B

281 834 0305 P. 17/19

## Replacement Page 119

hexadiene, cyclopentadiene, methyl cyclopentadiene, piperylene, methyl vinyl ether, ethyl vinyl ether, and isobutyl vinyl ether.

54. The copolymer of any of the preceding claims, wherein the copolymer is halogenated to form a halogenated copolymer.
55. The copolymer of claim 54, wherein the halogenated copolymer is halogenated with chlorine or bromine.
56. The copolymer of claim 54, wherein the halogen content is greater than 0.5 wt% based upon the weight of the halogenated copolymer.
57. The copolymer of claim 54, wherein the halogen content is from 0.5 wt% to 3.0 wt% based upon the weight of the halogenated copolymer.
58. The copolymer of any of the preceding claims, wherein the copolymer has a Mw of greater than 50,000.
59. The copolymer of any of the preceding claims, wherein the copolymer has a Mw of greater than 100,000.
60. The copolymer of any of the preceding claims, wherein the copolymer has a Mw of greater than 500,000.
61. The copolymer of any of the preceding claims, wherein the copolymer has a Mw of greater than 1,000,000.
62. The copolymer of any of the preceding claims, wherein the copolymer has a MWD of greater than 2.
63. The copolymer of any of the preceding claims, wherein the copolymer has a MWD of from 2 to 6.

NNU-30-2004 12:25

B

IPEA/US

281 834 0305

P. 18/19

Replacement Page 120

64. The copolymer of any of the preceding claims, wherein the copolymer has a Mooney viscosity of at least  $20 \pm 5$  (ML 1 + 8 at 125°C, ASTM D 1646).
65. The copolymer of any of the preceding claims, wherein the copolymer has a Mooney viscosity of from  $20 \pm 5$  to  $60 \pm 5$  (ML 1 + 8 at 125°C, ASTM D 1646).
66. The copolymer of any of the preceding claims, wherein the copolymer has a  $g'_{vis,avg}$  from greater than or equal to 0.980 as determined by triple detection SEC.
67. The copolymer of any of the preceding claims, wherein the copolymer has a  $g'_{vis,avg}$  from greater than or equal to 0.990 as determined by triple detection SEC.
68. The copolymer of any of the preceding claims, wherein the copolymer has a  $g'_{vis,avg}$  from greater than or equal to 0.995 as determined by triple detection SEC.
69. The copolymer of any of the preceding claims, wherein the copolymer has no long chain branching.
70. A blend comprising the copolymer of any of the preceding claims and a secondary rubber independently from the group consisting of at least one of natural rubber, polyisoprene rubber, poly(styrene-co-butadiene) rubber (SBR), polybutadiene rubber (BR), poly(isoprene-co-butadiene) rubber (IBR), styrene-isoprene-butadiene rubber (SIBR), ethylene-propylene rubber (EPR), ethylene-propylene-diene rubber (EPDM), polysulfide, isobutylene/cyclopentadiene copolymer rubber, isobutylene/methyl cyclopentadiene copolymer rubber, nitrile rubber, propylene oxide polymers, star-branched butyl rubber and halogenated star-branched butyl

NOV-30-2004 12:25

B

| PESA/US

281 834 0305

P.19/19

Replacement Page 121

rubber, brominated butyl rubber, chlorinated butyl rubber, star-branched polyisobutylene rubber, star-branched brominated butyl (polyisobutylene/isoprene copolymer) rubber; poly(isobutylene-*co*-*p*-methylstyrene) and halogenated poly(isobutylene-*co*-*p*-methylstyrene), halogenated poly(isobutylene-*co*-isoprene-*co*-*p*-methylstyrene), halogenated poly(isobutylene-*co*-isoprene-*co*-styrene), halogenated poly(isobutylene-*co*-isoprene-*co*-*a*-methylstyrene) halogenated poly(isobutylene-*co*-isoprene-*co*-*a*-methylstyrene), and mixtures thereof.